STATE OF CALIFORNIA

AIR RESOURCES BOARD

QUALITY ASSURANCE

VOLUME II

STANDARD OPERATING PROCEDURE

FOR

AIR QUALITY MONITORING

APPENDIX AH

ENVIRONMENTAL SYSTEMS CORPORATION 8800 DATA LOGGER

MONITORING AND LABORATORY DIVISION

OCTOBER 1997

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AIR RESOURCES BOARD

AIR MONITORING QUALITY ASSURANCE

VOLUME II

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APPENDIX AH.1

STATION OPERATOR'S PROCEDURES

FOR THE

ENVIRONMENTAL SYSTEMS CORPORATION 8800 DATA LOGGER

MONITORING AND LABORATORY DIVISION

OCTOBER 1997

AH.1.0 GENERAL INFORMATION

AH.1.0.1 SYSTEM DESCRIPTION

The Environmental Systems Corporation (ESC) 8800 data logger is a microprocessor-based, data acquisition system designed specifically to acquire, process, store, and telemeter environmental data. The standard unit consists of a microprocessor, analog input multiplexer, programmable gain amplifier, analog to digital converter, random access memory (RAM), read only memory (ROM), power supply, battery backup for the clock, and data storage and a keyboard/display. Figure AH.1.0.1 shows a simplified block diagram of the 8800 data logger. A brief description of the major data logger components follows.

Table AH.1.0.1 shows the air monitoring stations on the ARB Data Acquisition System.

AH.1.0.2 PHYSICAL DESCRIPTION

1. Analog Inputs - The standard 8800 data logger accepts up to 8 differential analog inputs (8 additional inputs optional) with 4 full-scale voltage range choices of ±100mV, ±1V, ±5V, or ±10V. The analog input section is composed of a multiplexer to select the line to be sampled, a programmable gain amplifier for input voltage range selection, and a 12-bit analog-to-digital converter.

   The analog input multiplexer samples each input line at a rate of approximately once per second. A programmable gain amplifier is then used to allow each channel to be individually configured in software to one of the four input voltage ranges given above. The analog-to-digital converter then converts the information.

   For 16-channel data loggers, the analog inputs are true "differential" type inputs, meaning that the data logger measures the difference in voltage between the positive and negative terminals for each channel. The 32-channel loggers are single-ended analog inputs, which share a common ground. A voltage of up to 11 volts (relative to ground) that is common to both terminals (common mode voltage such as noise) is canceled and does not affect the signal voltage.

   The analog-to-digital converter (A/D) has a resolution of 12 bits, plus an additional "sign" bit, with a temperature stability better than 25 parts per million (PPM)/C. The use of high quality components throughout the

instrument results in a guaranteed accuracy of ±0.1% of the full-scale analog input voltage range for all ranges.

2. Real Time Clock - The real time clock is crystal controlled and the date, hour, and minutes are easily set by the operator, both remotely via telephone with modem and locally via keyboard/terminal. (The year and all leap-year information is controlled by the microprocessor and is stored in CMOS RAM.)

3. Random Access Memory - The standard 8800 data logger is supplied with 24 Kbytes of RAM for operation system use, plus 32 Kbytes of data storage RAM, which is sufficient to store approximately 1 month of hourly averages for 6 instruments. The data RAM for the 8800 data logger can be expanded to 224 Kbytes (in 32 Kbyte increments).

   Optionally, an external RAM cartridge interface can be supplied, which allows data storage in removable solid state cartridges. These cartridges are available with memory capacities from 64 to 512 Kbytes. The logger automatically recognizes the installed memory size and addresses it properly, thus making it easy to expand memory as storage needs grow.

4. Battery Backup - The 8800 data logger offers two forms of battery backup. The first form is the use of a lithium battery to power the RAM and clock circuit during power interruption. This is standard on the 8800 data logger and is guaranteed to power the RAM data and clock for a minimum of 30 total days.

   The second option includes the standard lithium battery, but also includes an optional gel cell battery with battery charger. The gel cell battery offers charging, whereas the lithium battery can not be recharged. The gel cell battery is recommended in any areas where power outages are frequent or extended, which can cause discharging of the lithium battery and lost data.

   The gel cell with charger overcomes lost data by recharging after each power outage. The charger operates in two modes: a trickle charge mode is used when a power outage was brief, and a deep charge mode if the outage was severe. This two-charge process gives the highest guarantee against data loss.

5. Communication Ports - The standard data logger includes two RS-232 serial ports, as shown in Figure AH.1.0.1. One port is labeled External Modem for direct connect to a modem or computer for setup and data

retrieval. The second port, labeled RS-232, may be connected to a keyboard or printing terminal for local interface to the logger. Since the instrument operates in a multi-tasking mode, either (or both) of these ports may be active without interfering with the routine tasks of data collection and storage.

6. Digital I/O - Both digital status input lines and digital control output lines can be provided for the 8800 data logger (in groups of 8 to 16 maximum for both inputs and outputs). A typical configuration consists of 8 digital status input lines and 8 digital output control lines. All output control lines are solid-state optically coupled relays capable of switching up to 130 mA. Activation of these digital control output lines can occur automatically from data logger software, or on command, through one of the RS-232 ports.

   Digital input lines are used to monitor the status of events external to the logger (contact closures indicative of instrument calibration cycles, alarms, etc). The status of these lines is monitored continuously by the data logger. The information can be used to flag or invalidate data, or activate digital output lines.

7. Software - The data logger is supplied complete with operating program stored in non-volatile ROM. It automatically scans the analog inputs at a fixed rate, computes averages of all parameters, performs scaling, stores the data in RAM and transmits it on command to a central facility.

   In the event of a power failure and unit shutdown, the operating program will automatically reboot the data logger to the operating configuration software as soon as power is restored. In the meantime, the battery-backed clock and memory will retain all stored data, as well as the time of the power outage for later reporting and analysis.

   On start-up, the software automatically initiates a PROM test and reports the results. In addition, a system monitor EPROM can be provided which allows diagnostics to pinpoint hardware errors. The test routines can also be initiated from either of the RS-232 communication ports.

AH.1.0.3 CAUTIONS

1. To ensure reliable trouble-free operation, the AC power supply to the data logger should be free of large voltage transients and other line noise.

2. The "Ram Bat" switch at the rear panel of the data logger must always be "On" (Up Position) when the ESC 8800 is in service.

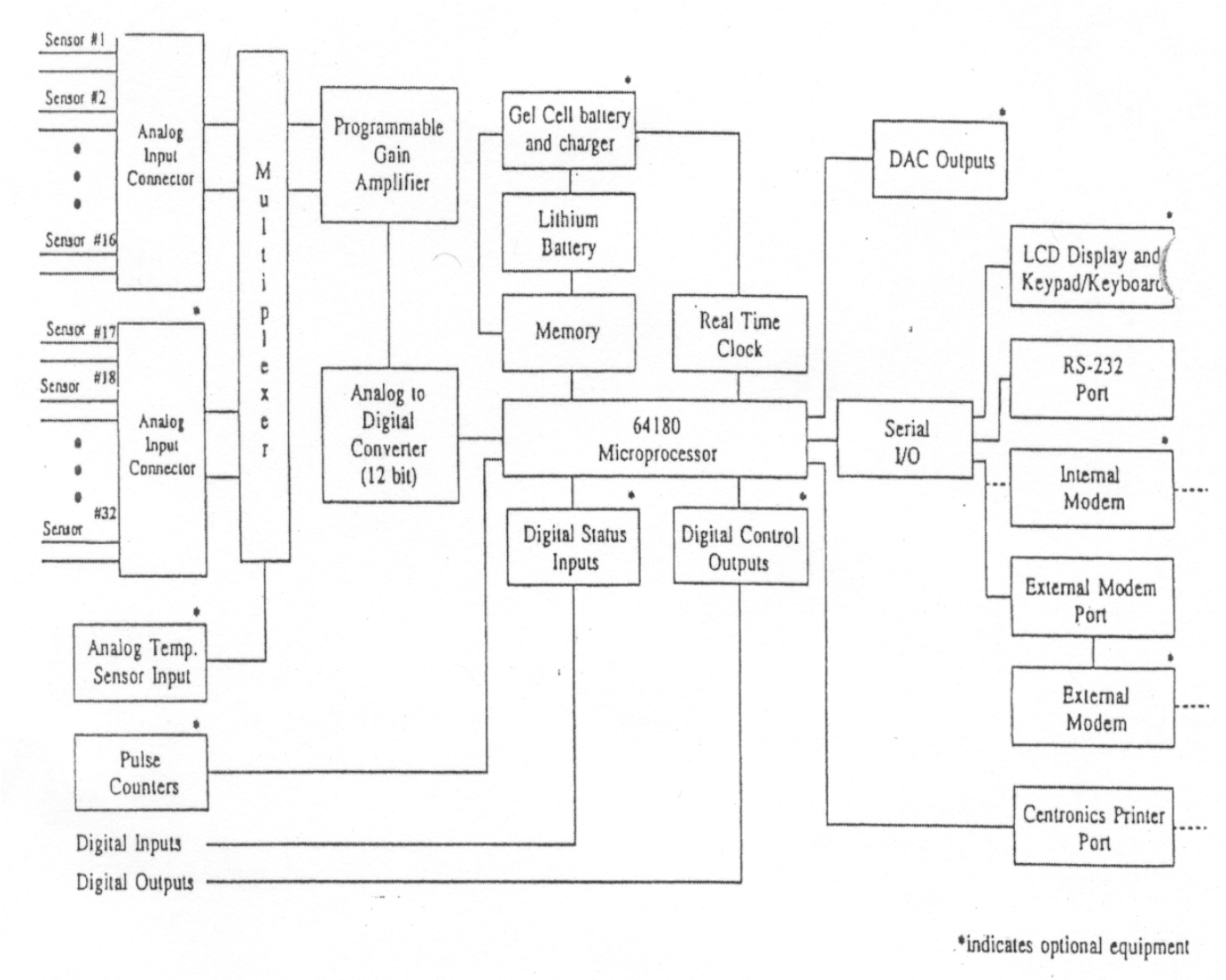

Figure AH.1.0.1
Diagram of ESC 8800 Data Logger

TABLE AH.1.0.1

AIR RESOURCES BOARD DATA LOGGER NETWORK

*DCN#	Station Name	ARB SITE#	DCN#	Station Name	ARB SITE#
01	Sacramento-T St.	34-305	36	Sequoia	54-571
			37	Yosemite	22-746
11	Arvin	15-247	38	San Andreas	05-633
12	Edison	15-242	39	Tracy	39-269
14	Oildale	15-243	40	Stockton-Mariposa Rd.	39-267
15	Shafter	15-248	41	Willows	11-673
16	Mojave	15-252	42	Gridley	04-636
17	Bakersfield-5558 Cal.	15-255	43	Pleasant Grove	51-897
20	Chico-Manzanita St.	04-628	44	Rocklin	31-820
22	Yuba City	51-898	45	Bethel Island	07-442
23	Chico-Salem St.	04-633	46	Lakeport	17-713
24	Arbuckle	06-645	47	Gasquet	08-654
25	Colusa	06-643	48	Davis	57-577
26	South Lake Tahoe-Sandy Way	09-691	49	Placerville	09-690
			50	Santa Barbara	42-388
27	South Lake Tahoe-Hwy. 50	09-693	51	Ventura	56-429
			52	San Luis Obispo	40-835
28	Stockton-Hazelton	39-252	53	Santa Maria	42-387
29	Stockton-Claremont	39-266	54	Upland	36-175
30	Fresno-First St.	10-246	55	Paso Robles	40-850
31	Visalia-Church St.	54-568	57	Calexico	13-698
32	Modesto-14th St.	50-568	60	Tahoe City	31-821
33	Jackson	03-614	61	Roseville	31-822
34	Fresno-Fisher	10-249	62	Sutter Buttes	51-899
35	Sonora	55-930	63	White Cloud Mtn	29-802
			64	Tuscan Buttes	52-910
			65	Tracy	39-270
			66	Jerseydale	22-744
			67	Shaverlake	10-250
			68	Sonora-5 Mile Learning Center	55-931

* Digital Collection Node

AH.1.1 INSTALLATION PROCEDURE

AH.1.1.1 INITIAL INSPECTION

The instruments are inspected both mechanically and electrically before shipment. First, confirm that there is no evidence of damage to the exterior of the shipping container. Carefully remove the data logger and optional equipment from the container. Check all parts against the packing list for completeness. Store the container and shipping materials for later re-use should it be necessary to support any damage claims or to return the instrument to the factory for repair.

Inspect all components for signs of physical damage. If there is any sign of damage, document your observations (photographs are recommended) and immediately file a claim with the carrier.

Note the instrument model number and serial number, which appear on a tag at the bottom rear of the data logger. This information should be included in any future communication with ESC regarding the instrument.

1. Panel Layouts - Please take a few moments to familiarize yourself with the following figures and accompanying text. They will be referred to at various points throughout the manual.

2. Front Panel - Figure AH.1.1.1 shows the front panel for a standard ESC 8800 data logger, consisting of:

   Keyboard
   LCD Display
   Data Cartridge Interface
   Contrast Knob

   If a DSC-80 memory cartridge interface option is installed, the data cartridge may be inserted. If this option is included on your data logger, please note that the cartridge should be installed or removed with the power off. The cartridge can only be installed with the printed side toward the display, as the connector slot is polarized to prevent incorrect insertion.

3. Rear Panel - A typical rear panel for an ESC 8800 data logger is shown in Figure AH.1.1.2. The rear panel may be fully populated with all the connections even if the options for the additional connectors are not implemented in your logger. Table AH.1.1.1 lists the ESC 8800 rear panel configuration.

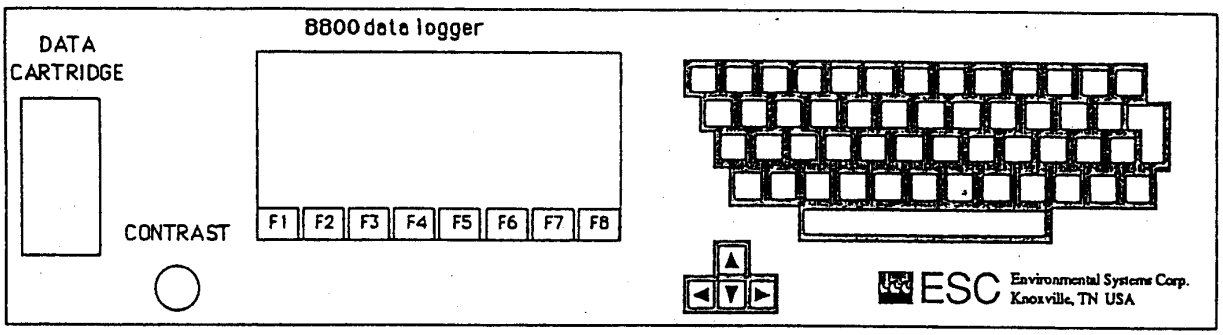

Figure AH.1.1.1
Front Panel of ESC 8800 Data Logger

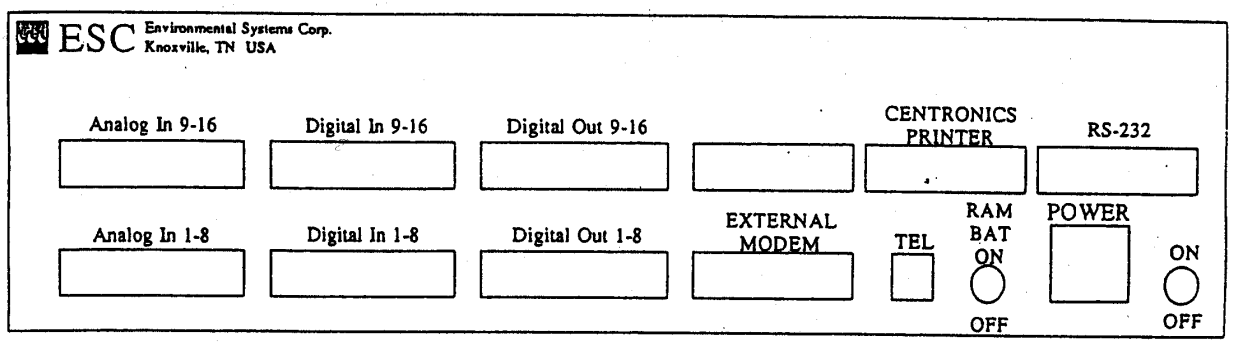

Figure AH 1.1.2
Rear Panel of ESC 8800 Data Logger

TABLE AH.1.1.1

8800 DATA LOGGER REAR PANEL CONFIGURATION

Designator	Description
Analog In -	Connectors for double-sided analog inputs. Normal configuration of 16 inputs, expandable to 32 single-ended inputs.
Digital In -	Connectors for digital inputs for status sensing. Normal configuration of 8, expandable to 16 with supplementary connector.
Digital Out -	Connectors for digital outputs for digital control of external devices. Normal configuration of 8 outputs, expandable to 16 through supplementary connector.
DAC Output Connector -	Outputs for the digital-to-analog converters in the 8800 data logger (not implemented on AMB systems).
External Modem Connector -	Serial port connection for an external modem for remote communication. May be directly connected to a computer for local communication.
Centronics Printer -	Allows direct connection to Centronics Printer.
RJ11 connector - (Labeled Tel on diagram)	Allows direct connection to phone line for internal modem. (Optional)
RAM Battery Switch -	Disconnects the internal battery output to prevent discharge during extended storage periods. This switch must always be "ON" (up position) when the 8800 data logger is in service.
RS-232 connector -	RS-232 serial port connection for local communication.
AC power connector	
Power Switch	

AH.1.1.2 INITIAL STARTUP

1. Refer to the rear panel configuration diagram as necessary when making the following connections and adjustments:

   a. Make certain that the "RAM BAT" switch on the rear panel is in the ON (UP) position, and that the rear panel power switch is in the OFF position.

   b. If the 8800 data logger has an optional DSC-80 RAM cartridge, install the cartridge and make sure it is securely seated.

   c. Connect one end of the AC power cord to the rear panel connector on the 8800 data logger and the other end to a source of 120 V AC power. Move the rear panel power switch to the ON (UP) position.

   d. With the LCD display or terminal connected as described previously, press the "RETURN" or "ENTER" key on the terminal. You should get the prompt DCN#??> followed by a flashing cursor, indicating that the data logger is ready to accept commands. If you do not get this response, repeat the terminal setup procedures as described in the previous section. Contact ESC if you are still unable to establish communication with the data logger.

2. DCN Prompt - The response DCN#??> is called the DCN prompt. DCN stands for "data collection node" which is another phrase for a specific data logger used in a data collection network. Throughout this manual, you may frequently find the data logger referred to as the "DCN". The DCN prompt indicates that ESC's proprietary software is enabled in the data logger, and that the logger is ready to accept commands. The characters “??” will be replaced by alphanumeric characters which provide a specific identification of this logger (or DCN) as will be shown later in this section.

3. Levels of Security - Before proceeding with further communications, let us first describe the levels of security which are designed into the data logger operating system to prevent unauthorized access to information or settings.

   a. Level 0 Access - At this level, only the command **TIME, HELP, VERSION, LOGIN,** and **SET PASSWORDS** are recognized. Communications through the RS-232 port or the front panel start here, but to use the External Modem port it must first be removed from Command/Response Mode. This mode is used for compact communications with Central Host.

b. Level 1 Login - Except as indicated above, the command **LOGIN** must be entered followed by the correct password at the PASSWORD prompt to obtain any data or status information from the data logger. From this level, the operator can check status, list channel information and retrieve stored data. However, commands which modify system parameters require a higher (privileged) status. The command response for login sequence is as follows:

Command: **LOGIN**
System Response: PASSWORD> Type LOGIN password (<CR> is default value)

LOGGED IN

c. Level 2 Privilege - To request privileged status, the command **SET PRIV** is issued, followed by the correct password at the PASSWORD> prompt. The commands which require privileged status are indicated by asterisks on the command list given in Section 5.6 of the Manufacturer's Instruction Manual. The command response sequence is:

Command: **SET PRIV**
System Response: PASSWORD> Type PRIV password (<CR> is default value)

PRIV PERMITTED

d. Level 3 PASSWORD KEY - In order to set or alter the LOGIN and SET PRIV passwords, the system password must be entered following the command **SET PASSWORDS**. The system password is embedded in the data logger software at the factory, and communicated verbally only to the system operations manager. The sequence for this command is:

Command: **SET PASSWORDS**
System Response: LEVEL-3 PASSWORD? (Type SYSTEM password)

PRIV PERMITTED

The logger then requests new PRIV and LOGIN passwords. To remove LOGIN and PRIVILEGED status, the command **BYE** can be issued at the terminal. This is done automatically if the terminal is disconnected and also if the modem answers or hangs up the line.

e. Initial Login and Privilege - At the prompt DCN#??> type the command **LOGIN**, followed by the "ENTER" or "RETURN" key. (NOTE: All commands require a carriage return or enter key, indicated by **<CR>**, to activate.) You should get the PASSWORD> prompt in return. If you get an ILLEGAL COMMAND response instead, check to make sure that the "CAPS LOCK" key is activated on your terminal. Remember, the data logger does not accept lower case letters in commands!!

As shipped from ESC, the default login password is a simple carriage return <CR>; therefore, press the "ENTER" or "RETURN" key again at the PASSWORD> prompt. You should get the response “LOGGED IN”. If something other than the expected password is entered, the message “LOGIN FAILED!!!” will appear. Check with your system manager to see if the login password has already been established. Upon successful login, you might get an additional message, since messages previously stored in the logger remote operator message buffer are printed out upon login. Certain commands, such as **TIME, DATE, HELP, VERSION,** etc., (see the data logger command list, Section 5.6 of the Manufacturer's Instruction Manual) are allowed at this level and may be entered at this point. However, privileged commands, (such as **SET TIME, SET ID,** etc.) are not allowed at this level and will produce an PRIV VIOLATION response.

To enter the next level of command access, type the command **SET PRIV** which produces the PASSWORD> prompt. Again, as shipped from ESC this password is simple **<CR>**; therefore, press **ENTER** or **RETURN** to get the “PRIV PERMITTED” response. The data logger will now accept all valid commands. (For a list of these commands, type **HELP <CR>**.)

4. Setting Time, Date and ID - Issue the command **TIME <CR>** and observe the response. The data logger operates on a 24-hour clock (military time); therefore, 1:00 p.m. will be displayed as 13:00:00 (hr:min:sc). Next, issue the command **DATE <CR>** and observe the result. The day of the week is displayed, followed by the date in the form of mo/dd/yr and the Julian day. If the time and/or date are incorrect, issue the command **SET TIME mo/dd/yr hr:min:sc <CR>** exactly in the format shown where mo/dd/yr is the correct date (month/day/year) and hr:min:sc is the correct time (hour:minute:seconds). Re-enter the **TIME** and **DATE** commands to assure that they are correct. If not, repeat the above **SET TIME** command. A relative command, **REPEAT TIME**, continuously reports

the time from the ESC 8800 data logger real time clock until another key is struck.

Enter the command **ID <CR>** to list the current identification codes and observe the response. You should get the response:

REMOTE ID = ??
REPORT ID = ?????????????????? (20 question marks)
Unless identification codes have already been established for the data logger.

The REMOTE ID is a 2-character alphanumeric code which identifies the particular data logger for use by a central computer (this code will replace the "??" in the DCN prompt, when established). The REPORT ID is a string of alphanumeric characters and/or punctuation marks up to 20 characters long, which can be used to establish a more detailed description of the location or function of the data logger. This identification code is not used by the central computer except in the heading of formatted data reports. Issue the command **SET ID** xx Text <cr>, where "xx" is 2-character alphanumeric and "Text" is up to 20 characters, (including punctuation). For example, **SET ID** 1A KNOXVILLE, TENNESSEE. The logger will respond with:

REMOTE ID = 1A
REPORT ID = KNOXVILLE, TENNESSEE

From this point on, you will get the same response at the **ID** <cr> command, and the "xx" value will appear in your DCN prompt (DCN#xx>).

5. Logger Memory Test - If a terminal or the LCD display was not already connected when you turned on the data logger, you may not have yet established communications, and therefore, did not notice the logger "self test" when power was applied to it. Turn the power switch on the data logger to the "OFF" position for a few seconds, then turn it back "ON" and note the response on the terminal. Whenever power is applied to the logger, it performs internal diagnostic checks. The display should show "ENTERING PROM TEST" followed by "AQM MEMORY TEST OK", indicating that the tests were performed and the logger memory is responding normally. If the display did not show the "AQM MEMORY TEST OK" response, contact the ESC service department.

   Memory tests can also be initiated at the privileged level by typing the TEST command. The data logger should respond with:

ENTERING PROM TEST
ENTERING RAM TEST or ENTERING CARTRIDGE TEST
TESTING 32K RAM
TESTING 64K RAM (Reports in 32K increments to Max. RAM)
AQM MEMORY TEST OK

There is one additional response that can appear with the DSC-80 RAM cartridge option. If the logger does not have internal data RAM, the logger will recognize if the memory cartridge is not installed or fully seated. The display will show the message "NO DATA RAM FOUND" on power up or whenever attempting to read stored data. Initial testing of the data logger is now complete, and you may proceed with installation at this point. Since the instrument was calibrated at the factory, it is not necessary to repeat calibration procedures on initial checkout.

When you have completed your familiarization with the instrument, return the data logger power switch to the "OFF" position and disconnect the AC power cord. Turn off the terminal and disconnect it from the logger. Do not turn off the "RAM BATT" switch on the logger rear panel unless the data logger is to be inactivated for more than one month. Doing this will erase all data stored in internal RAM, as well as your TIME, DATE, and ID settings. These parameters will require resetting and the performance of a cold start (turning the power off with the "RAM Battery" switch off).

AH.1.1.3 INSTALLATION

1. Environmental Requirements - The data logger will operate satisfactorily over the temperature range of 0 to 50°C and relative humidity ranging from 0 to 95%, non-condensing. It should not be installed outdoors without protection from the elements. A heated and moisture-proof (or moisture controlled) enclosure is recommended. Please contact ESC if there are any questions concerning the operating environment for the ESC 8800 data logger.

2. Analog Inputs - Before connecting any instrument to the ESC 8800 data logger, make certain that the instrument output voltage is compatible with the analog input range of the data logger. The logger will accept full scale input voltages of ±100mV, ±1V, ±5V, and ±10V. The correct voltage should be selected during the channel initialization procedure.

   The data logger will correctly read voltages up to 102% of the full-scale input. Voltages above this value cannot be read. For example, on the 10-volt scale, an input voltage of 10.2 volts will be properly stored, but 10.3 volts will not be read and will produce a "+" error code. Overranging

(i.e., voltages too high to measure but not too high as to cause damage to the data logger) is allowed up to 2 times the full-scale input voltage.

The data logger analog inputs are "differential"; however, some "common-mode" voltage is allowed. The voltage must not exceed 11 volts with respect to the logger AC ground. If exceeded, the logger will not be able to measure the differential voltage accurately and some type of isolation is required. Contact ESC for additional information.

Instruments with other type outputs (such as 4-20 mA current outputs) must first be connected to a signal converter to give the proper voltage output for the data logger inputs.

To connect instruments to the data logger, use 22 gauge (or larger), twisted-pair, shielded cables. Connect the shield to AC ground at either the instrument or the data logger, but not both. On the data logger end, remove approximately 3/8" of insulation from the + and - leads. Insert the bare wire into the appropriate lug on the screw connector and tighten the screw. Ensure that only the bare wire (not the insulation) is crimped behind the lug and that the lead is not shorted to the chassis. Note that these connectors are removable.

NOTE: Refer to Figure AH.1.1.2. For 16 channels (double-ended), the connections for channels 1-8 are on the bottom terminal. Channels 1-8 are marked, from left to right, (+1-, +2-, etc.). Channels 9-16 (if applicable) are similarly marked on the top analog terminal. For 32 channels (single-ended), channels 1-16 are on the bottom terminal strip. Each terminal strip has a ground point at either end.

If the instrument has only one voltage output terminal, connect the negative lead to analog ground, at the instrument, and proceed as described above at the data logger.

3. Digital Input/Output - If digital input or output options are supplied with the ESC 8800 Data Logger, the rear panel connectors marked "Digital In 1-8" have been pre-wired internally (see Figure AH.1.1.2.)

   Digital input lines are "active low" and are considered digital zero when a 5-volt signal or no connection is made (due to a pull-up resistor and an inverter on the input). The input is considered active, or digital one when 0 volts is input to the line (i.e. it is connected to ground). Digital output lines are software controlled and are optically isolated solid-state relays mounted internally and capable of switching up to 130 mA each.

4. Communications - If the data logger is to be used in a network of remote sites, some method of communication must be established with the central computer. Auto-dial, auto-answer telephone modems are frequently used. Three modem configurations are offered as options for the ESC 8800 Data logger.

   External modems provided by ESC are shipped with the necessary cabling and the appropriate commands preset. User supplied modems must be auto-dial, auto-answer, asynchronous, Bell 103 compatible @ 300 BPS and/or Bell 212A compatible @ 1200 BPS and must utilize the Hayes "AT" compatible command set. Connections for the external modem are as follows:

   a. Plug one end of the phone cable (supplied with modem) into the modem phone jack and the other end into the telephone wall jack.

   b. Connect an RS-232 cable between the modem and the ESC 8800 data logger rear panel External Modem connector (see Figure AH.1.1.2).

   c. Connect one end of the modem power adapter into the appropriate connector on the modem and the other end into a source of 120 VAC power. If the ESC 8800 Data logger is rack mounted, the auxiliary AC power connector on the data logger rear panel (see Figure AH.1.1.2) may be used. This completes the hookup of the external modem.

      Dedicated line modems are generally specified by the user. Please refer to the modem instruction manual for installation information.

5. Installation Completion - After completing Sections AH.1.1.3.2 through AH.1.1.3.4, connect the data logger as described in Section AH.1.1.2, turn the power on, and verify that the time, date, and ID have been set correctly (Section AH.1.1.2.4). You may now proceed to initialize the data logger input channels.

AH.1.1.4 INITIALIZATION

The ESC 8800 Data Loggers are normally pre-configured before shipment and installation in field sites. For detailed initialization procedures, refer to Section 4.0 of the ESC 8800 Engineering Manual.

AH.1.2 TROUBLESHOOTING

This section is provided for use by electronic technicians to troubleshoot the ESC 8800 Data Logger. Circuit diagrams and component layouts referred to in this section may be found in Section 9 (Technical Drawings) of the ESC 8800 Engineering Manual. Standard electronic troubleshooting equipment is necessary to follow these procedures (e.g. DVM, oscilloscope).

If questions arise, contact the ESC Service Department.

1. LOGGER DOES NOT POWER UP

   a. Check for D.C. voltages on CN-13 of RMC (Ref. drawing 109-1000- C).

      Pin 1 = GND
      Pin 2 = +5.12V ±2%
      Pin 3 = VCH 18-26 VAC ½ Wave Rectified
      Pin 4 = VBL +15V, ±5%
      Pin 5 = +15 ±5%
      Pin 6 = -15V ±5%
      Pin 7 = NC

   b. If the voltages are correct, the logger should still operate. Continue troubleshooting at Section AH.1.2.1D.

   c. Disconnect CN-13 from the RMC and check power output readings. Output voltages should be the same as for AH.1.2.1A. If the voltages change, the power supply is defective.

   d. Check the voltages of power reset circuitry (Ref. drawing 109-1000- C). Verify the voltages on the board are correct (i.e. 5 V on pin 14 of 14 pin chips). The voltage at pin 1 of U55 should be low (<0.8 V). If not, adjust voltage using a potentiometer or replace U55.

2. NO PROMPT WHEN <CR> KEY STRUCK

   a. Ensure the following:

      - Connected terminal is working correctly.
      - Flat ribbon cable is connected properly and no breaks or shorts exist.
      - Terminal transmits characters on Pin-2 and receives characters on Pin-3. Therefore, the terminal must be set as data terminal equipment (DTE).

- Terminal is set for 8-bits, no parity, 1 stop-bit, asynchronous communication, no local echo mode of operation.

If in doubt, try the terminal with a separate ESC 8800 Data Logger that is known to be working correctly.

b. Turn the power switch off for 30 seconds then back on. If the self-diagnostic check and prompt are printed and the ESC 8800 Data Logger now responds to <CR>, then the software was locked up. This may happen on rare occasions (power glitches, etc.); however, if it happens on more than one data logger, or twice on the same data logger, then ESC should be notified or the power conditioning circuitry should be verified for proper operation (see Section AH.1.2.1D).

c. If the diagnostic check is printed, but the logger still does not respond to a <CR>, then recheck the cable and terminal before continuing troubleshooting at Section AH.1.2.2I.

d. If the diagnostics check message is not printed, check the cable and terminal once again before proceeding. If everything is properly connected, perform a cold-start on the data logger as follows:

- Turn power off with the switch.
- Disable the RAM battery with the "RAM BAT" switch found on the rear panel.
- Re-enable the RAM battery.
- Turn power on.

If this restores operation, ESC should be notified as to the circumstances of this condition.

e. With the original EPROM’s installed, probe Pin-1 of U-55 on the RMC (Ref drawing 109-1000-C). It should be low (<0.8V). Temporarily short between Pin-1 of CN-15 and Pin-2 of CN-15. The collector of Q9 should be low (<0.8V) and return high when the short is removed. Short Pins 1 and 2 again. If this point still does not go high, check Pin-3 and 4 of U-9 (clock frequency of 6.144 MHz) for proper operation.

f. The following frequencies should be found on the indicated pins. If not, call ESC for further troubleshooting information.

- CPU Clock - 6.144 MHz, U9-Pin 3 and Pin-4
- KEY Clock - 1.536 MHz, U27-Pin 3
- A/D Clock - 122.88 kHz, U28-Pin 22, U27-Pin 10

- o REAL TIME INTERRUPT CLOCK - 32.768 kHz U17-Pin 16 and 17
- o SYSTEM OSCILLATOR - 3.072 MHz, U27-Pin 1 and 4

g. The following pins should be active (toggling from high to low at some indeterminate frequency).

- o U9-Pins: 14-33, 37-44

If one or more of these pins are inactive (stay high or low), then call ESC for further troubleshooting information.

h. If a second working ESC 8800 Data Logger is available, then try swapping the following chips one at a time between the two loggers. Power down the logger under test, including the battery, before swapping a chip, and turn the power on again after the new chip has been installed. Be sure to wait for diagnostic check message to be printed each time. Be very careful about inserting chips in the proper orientation and in the correct socket. Also, ensure that all of the pins are inserted correctly without bending any pins.

- o U19
- o U18
- o U9
- o U28
- o U17
- o All EPROM’s (usually U12, U13)
- o All RAMs (usually U1-U3)

i. If the data logger still doesn't operate correctly, it should be returned to ESC for repair.

3. <u>DOES NOT RESPOND TO “HELP" COMMAND</u>

If the ESC 8800 Data Logger responds to a <CR> with a prompt but does not respond to commands such as "HELP" correctly, check the terminal and cable as in Section 7.2. If the data logger responds to a <CR> with a prompt, then it is probably working correctly.

4. <u>FAILS SELF TEST</u>

If the EPROM or RAM test fails, then contact ESC for replacement parts and instructions on how to install them.

5. LOSES OR CORRUPTS DATA ON POWER FAIL

a. The ESC 8800 Data Logger is designed to operate under poor power conditions without corrupting data. However, under extreme conditions, the data logger may lose part or all of its data.

b. To restore the operation, the data logger should be cold-started as described in Section AH.1.2.2D. If the data logger now appears to function normally, it should be placed back into service. If it seems to malfunction systematically, continue following the troubleshooting.

c. With the power on, verify the D.C. voltages as in Sections AH.1.2.1A, AH.1.2.1B, and AH.1.2.1C. If any of these voltages are incorrect, follow the troubleshooting procedures in Section AH.1.2.1 before returning here.

d. With the power switch off, but with the RAM battery switch on, verify the following voltages:

o	CN-14, Pin 2 $\geq$ 2.0	If not, continue with Section AH.1.2.5E.

e. Remove the Lithium battery and measure its terminal voltage. If it measures 2.5 V or more, check the RAM battery switch and the wiring harness for continuity. If it measures below 2.5 V, the Lithium battery has been discharged and should be replaced.

6. MODEM WON'T COMMUNICATE

a. Check continuity of phone cables and connectors.

b. Turn the power off to the modem by turning the power switch to "off" on the data logger.

c. Restore power after a few seconds delay. If the problem is not resolved, the modem should be replaced.

d. If the problem re-occurs, the problem is most likely the modem.

7. LITHIUM BATTERY REPLACEMENT

The Lithium battery supplied with the ESC 8800 Data Logger is used for continued power of the CMOS RAM and Clock circuit in the event of power interruption. ESC suggests that the Lithium battery be replaced on a yearly basis to facilitate safe collection and storage of data in the data logger.